KNOWLEDGE
AN ILLUSTRATED
MAGAZINE OF SCIENCE
PLAINLY WORDED—EXACTLY DESCRIBED

LONDON: FRIDAY, FEBRUARY 23, 1883.

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Science and Art Gossip.

Dr. R. S. Ball is giving a course of lectures on the "Supreme Discoveries in Astronomy," on Tuesday afternoons, at the Royal Institution. There are few better or brighter lecturers than the Astronomer-Royal for Ireland, and these lectures should be well attended.

When men of science misunderstand the position of science, we cannot wonder that those who view science from without should fall into mistakes. Dr. Romanes pointed out recently in the *Contemporary Review*, quite correctly, that there is no point of contact between the sphere of natural science and the sphere of supernatural religion; and in particular that science supplies no evidence, still less proof of design. On this, Professor Asa Gray asks if Dr. Romanes is quite sure that the observed fitness of organs for their purpose could have come, even by gradual processes, otherwise than by the direct intervention of intelligence? To this, of course, the answer is that science can be sure of nothing of the sort,—simply science now knows of no evidence of such direct intervention. What was once thought to afford such evidence is now seen to afford none whatever. But there may not have been a single link in the chain of biological progression which—for aught science has proved to the contrary—might not have required special intervention to cause it to be precisely such as it was.

The Austrian Government Sanitary Council has prepared a set of regulations for life-saving on railways, and a guide to first help to those injured by accidents until the arrival of a physician. These have been sent to the several railway companies for examination and suggestions. Every conductor is to be provided with a leather case of bandages; a litter to be placed at every station and half-way between such stations as are more than nine miles apart; at every station a small case of surgical instruments, of specified kinds, is to be kept; that a larger supply of instruments and bandages are to be kept at stations fifty and sixty miles apart, where there are reserve locomotives, which locomotives are to pick up the cars and litters on the way to an accident. Still more complete provision is to be made at important stations where there are many servants. For every 250 or 300 miles of road, at an engine-house, there must be an hospital car, of a specified pattern, used for carrying sick and wounded in time of war. The guide to first aid to the injured prescribes how the servants or others shall carry the victims of accidents, how place them, treat their wounds, apply bandages, transport them in the cars, and what to do in case of sudden illness.

The following account (from Mr. Oswald's "Zoological Sketches") of the behaviour of a Siamese bonnet-macaque monkey (*Macacus radiatus*) will interest those of our readers who read (*redde*) the papers on "Intelligence in Animals," republished in *Leisure Readings*:—"His conduct under circumstances to which no possible ancestral experiences could have furnished any precedent, has often convinced me that his intelligence differs from the instinct of the most sagacious dog as essentially as from the routine knack of a cell-building insect. His predilection for a frugal diet equals that of his Buddhistic countrymen, and I have seen him overhaul a large medicine-chest in search of a little vial with tamarind jelly. He remembered the shape of the bottle, for he rejected all the larger and square ones, and after piling the round ones on the floor, he began to hold them up against the light, and sub-divide them according to the fluid or pulverous condition of their contents. Having thus reduced the number of the doubtful receptacles to something like a dozen and a half, he proceeded to scrutinise these more closely, and finally selected four, which he managed to uncork by means of his teeth. Number three proved to be the bonanza bottle, and, waiving all precautions in the joy of his discovery, Prince Gautama left the medical miscellanies to their fate, and bolted into the next room to enjoy the fruits of his enterprise."

Electric light apparatus has been fitted throughout H.M.S. *Himalaya*, and gives great satisfaction. It is interesting to notice that the light is being very extensively adopted in large steamers. One has only to make a brief voyage to become acquainted with the disagreeable nature of oil lighting, and if the cost for the newer illuminant is a little higher, the gain is almost incalculable.

By an inadvertency (no fault of the compositors) the port and starboard side-lights on p. 104 were interchanged, or rather the names were. The upper set are, of course, starboard lights, the lower are port lights. The article was corrected, but not returned to the printers, having fallen among some newspapers on the editor's floor. In the last line of the article the word "foregoing" should have been "foreshortened."

Sir Trevor Lawrence, says the *Globe*, and the gentlemen who have been associated with him in the praiseworthy effort to make the Royal Gardens at Kew more useful to the general public of London, must be heartily congratulated on the concession which Mr. Shaw-Lefevre was recently enabled to announce. Sir Joseph Hooker has come to the conclusion that the Gardens may be opened an hour earlier than heretofore, "without interfering with the important work carried on there." From the 1st of April, therefore, the public will be admitted at twelve o'clock, instead of at one. This, it may be remembered, is not the only benefit for which we have to thank the association with which the honourable

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member for Mid-Surrey has so usefully co-operated. A few months ago the Director of the Gardens was persuaded, as the result of their efforts, to reconsider his proposal to shut up the Richmond entrance-gate, which would have increased the distance to be walked or driven over by the very numerous visitors who reach Kew Gardens by the various railway lines converging at Richmond by some three-quarters of a mile. We trust, however, that Sir Joseph Hooker will not take it amiss if the arrangement which is to come into operation this spring is considered not to be quite satisfactory. Twelve o'clock is a better hour for opening the Gardens than one, but it has always been contended—and in our view the contention has never been upset—that there is no adequate reason for keeping the gates closed after ten. The visitors would not be numerous enough at that early hour to interfere in any way with the work going on, and the extra cost which might be incurred for police or other attendance would be inappreciable. We believe, however, that all reasonable requirements would be met if the Gardens were opened, except on bank holidays, at eleven o'clock. The gardeners begin their work, when the daylight permits, as early as six in the morning, and they would thus have five hours without any disturbance from visitors. We have no doubt that the twelve o'clock opening will be found to occasion no inconvenience to the Director or his assistants, and we trust, therefore, to the concession of another hour next year. With that, we believe, everybody will be satisfied.

The Effect of the Electric Light upon Plants.—M. P. P. Déhérain has made a series of interesting experiments at the Palais d'Industrie, Paris, and communicated the result to the *Annales Agronomiques*. The author sums up his conclusions thus:—1. The electric arc light emits radiations which are injurious to vegetation. 2. Most of these radiations are arrested by colourless glass. 3. The electric light emits radiations powerful enough to maintain mature plants in vegetation for two months and a-half. 4. The beneficial radiations are not sufficiently powerful to cause the growth of germinating seeds, or to allow of the maturation of fruit in older plants.

Dr. D. E. Salmon, of America, has pursued parallel investigations with those of M. Pasteur, of the microbe of hen cholera, and has conclusively satisfied himself of the accuracy of the results announced by the latter. He regards his researches as demonstrating that the virulent liquids of the fowl's body contain micrococci, that these can be cultivated, and that liquids in which bacteria are cultivated produce the disease by inoculation. His experiments indicate that the activity of the virus is destroyed at a temperature of 182° Fahr.

The sea serpent is again talked of; but this time it seems as though the supposed sea monster had been a flight of sea birds. And because an object a mile or more away, taken for a sea monster, has turned out over and over again to be sea-drift, or a lot of porpoises, or a flight of birds, or distant undulating hills seen indistinctly through disturbed and hazy air, it of course follows that the long-necked creature which the captain and officers of the *Dædalus* saw within 200 yards, at a distance at which a friend's face could be recognised, urging its way swiftly against a ten-knot breeze, with the water visibly surging against its neck, was seaweed round a mast, or something of the sort.

M. Bergeron has produced imitations of the forms of lunar craters, by turning a current of gas into a melted metallic mass at the moment when solidification is about to begin. He obtained exact representations of the different varieties of hollows shown upon the moon, by using different metallic mixtures.

According to Mr. G. Macloskie, the American elm-leaf beetle hibernates in cellars and attics in countless numbers. Three broods are brought forth in a season. This destructive insect is found only in the Eastern States and parts of New Jersey and Pennsylvania. Poison is the most complete remedy for it—one pound of London purple to one hundred gallons of water, squirted up into the tree.

A Queer Fish.—The *Travailleur* dredged up from a depth of 2,300 mètres (2,515·356 yards), on the coast of Morocco, a fish, which has been named *Eurypharynx pelecanoides*. To form an idea of it, let two tablespoons, with pointed ends and deep bowls, be held so as to represent a great open mouth. The body and tail thin off rapidly, and may be likened to a slender spoon handle. They are ornamented with pin-like rows of soft spines. The creature is 18½ in. long, and the thickest part of its body about 8-10 in. wide. The head, without reckoning the jaws, is short, 3 centimètres (1·181 in.); the jaws extending nearly 4 in. The mouth opening is enormous. There are five internal gills, with a small external orifice for the escape of the water. The skull is peculiar, the upper jaw being reduced to a thin rod, united to the head and the interior portions of the body by an extensible cutaneous fold. The mouth is capable of pelican-like expansion. It is supposed to form a magazine for food, and that digestion is partially carried on there. The fins are extremely small. Professor Vailliant has described the fish to the *Institute*.

The Colour of Water.—M. W. Spring, in a lecture at the University of Liège, described his experiments to ascertain the colour of pure water. He referred to the researches of Stas, who found that common spring water, distilled twice over and immediately evaporated in a platina basin, volatilized without leaving any residue; but if this water were kept for a few days, and then evaporated, it left a perceptible yellowish brown deposit, which at a red heat, in air, could be completely burnt. To obtain water quite free from this matter, Stas' plan was followed. The water was first boiled for four hours over potash manganate and permanganate, and then distilled twice in platina vessels, and the product received in a silver vessel protected from contact with the air. This water, when evaporated from a well-polished capsule of platina, left no stain. In order to obtain the requisite depth of water for the light to pass through, and make any colour it would give visible, M. Spring used glass tubes 16 ft. long, and rather more than 1½ in. wide. The tubes were closed at both ends by glass flats, and furnished with a pipe through which the water could be introduced. When pure water was placed in these tubes and white light sent through it, the colour "was of a blue of which it is difficult to represent the purity; the finest blue on a fine day in a mountain region, above the grosser emanations of the soil, can alone be compared with it." No change occurred when the water was kept in the tubes for several weeks. The addition of a little lime-water, which appeared quite limpid, entirely stopped the passage of the light, "as if ink had been put in." The lecture is reported fully in *Revue Scientifique* Feb. 10, 1883.

XUM

HOW TO USE OUR EYES.

By John Browning, F.R.A.S.

IT might at first thought appear that it cannot be necessary for any person to learn to see. A moment's consideration will show that this is a mistake. Before an artist can draw any object well he must be able to see the most delicate lights and shades upon its surface. I have often been surprised at the remark that "a photograph is much more beautiful than the landscape it was taken from." Now I know the speaker *could not see* the landscape.

It is stated that a lady observed to the great artist, Turner, pointing to one of his pictures, "Dear me! Mr. Turner, I never saw anything like that!" "No, madam," answered Turner; "don't you wish you could!"

Those who are in the habit of using microscopes or telescopes can see minute details or an object which would not be visible to a person who looked through one of those instruments for the first time. The remark is frequently heard that a particular person is an excellent judge of some article. It will generally be found that the person can *see* differences in various samples of the article which are not visible to most people.

A good photograph of a statue appears almost solid. This is due entirely to the delicate *shades* being faithfully represented in the photograph. There are but few persons whose sight would be keen enough to enable them to detect the whole of these shades on the original statue. This is the principal reason that a drawing, however beautiful or truthful, never looks as solid as a photograph.

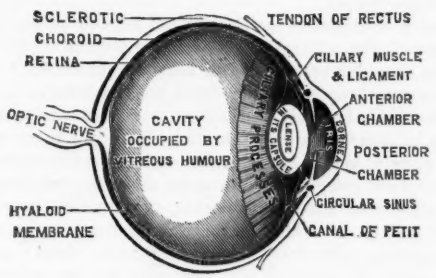

Fig. 1.

Fig. 1 is a diagram of the eye, which shows the Cornea, the Iris, the Ciliary Muscle, the Crystalline Lens, the Aqueous Humour, the Retina, and the Choroid Coat.

The outer white coating of the eye is called the sclerotic. The central portion of the eye is known as the cornea; behind this is the iris, the coloured portion of the eye. There is an opening in the centre of the iris known as the pupil; this is simply an aperture through which light can pass. This aperture opens when the eye is in a faint light, and closes when it is exposed to a strong light. The space between the cornea and the iris is filled with a watery fluid. Just behind the iris is the crystalline lens. This is popularly supposed to be the pupil of the eye, and you have doubtless heard the expression, having the pupil taken out of the eye. Now, you could no more take the pupil out of an eye than you could take a keyhole out of a door, as it is simply an opening which admits light into the crystalline lens.

Outside the iris is the ciliary muscle, a ring of muscular fibre. This muscle makes the crystalline lens more convex whenever we look at an object within a few feet of us. The whole space of the eyeball is filled with the vitreous humour, a jelly-like substance.

The back part of the inside of the eyeball is covered with a most exquisitely sensitive nerve tissue, known as the retina. On this retina a picture of any object in front of the eye is formed. The optic nerve extends from the brain to the back of the eye, and small branches of it extend all over the retina. These convey to the brain the information as to the kind of picture which is formed on the retina. Outside the sensitive surface or retina there is a coating of black pigment, known as the choroid coat, which serves as a background to stop rays of light which might otherwise pass through the retina.

There are several large muscles round the outside of the eyeball. By means of these the eye may be moved to either side or upwards or downwards, so as to get a clear view of any object.

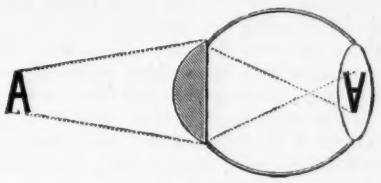

Fig. 2.

Fig. 2 is not an anatomical, but a rough mechanical and optical model of the eye. It is made of an opal lamp globe, with large openings at the top and bottom. On one side is a common bull's-eye; this represents the crystalline lens. The other opening is covered with a piece of partially transparent tracing-paper. This receives the image formed by the bull's-eye or crystalline lens. It will be seen that the letter A appears reversed; in simple language, it is upside down. So are the images of the objects we see on our retina; they are all upside down.

One of my scientific friends, the brother of one of our most distinguished musical composers, has taught himself to read print when held upside down. Occasionally he will read a book in this manner when he is travelling in an omnibus or a railway-carriage. It is not long before some passenger draws his attention to the fact that he is holding the book the wrong way. Their astonishment is great when he quietly informs them that he prefers reading with the book held in that direction. I am afraid that occasionally they have doubts of my friend's sanity. If I have explained the action of the eye with sufficient clearness, you will at once understand that the letters of the book held upside down really appear upon my friend's retina in an erect position.

Sometimes the question is put to me, "Will you believe your own eyes?" To this I reply, "As an optician, certainly not."

Numerous ways in which the eyes can be deceived are no doubt familar to you. The best-known of all is, perhaps, that known as Pepper's Ghost. In this optical illusion a number of persons appear to be upon a stage or platform in front of the audience; in reality they are before the stage, but out of view of the audience.

How easily our eyes may be deceived may be proved by a very simple experiment which you may make. Take a large card—the size is of no consequence. Make a large black circular spot on the card, on the right-hand side, one inch in diameter, then at a distance of three inches from it, on the left-hand side, make a black dot the size of a pin's head. If you hold this card at exactly one foot from your right eye and look intently at the small dot, the large black

circle will not be visible. This arises from the fact that a portion of the retina is not sensitive to light. The invisible portion is so large that it will suffice to prevent a man's face from being seen at six or seven feet distance.

When looking for very minute stars, or other faint objects difficult to see, practical astronomers look for them sideways, out of the corners of their eyes. The centre of the retina is not so sensitive as the outer portions, which are much less used.

(To be continued.)

A NATURALIST'S YEAR.

By Grant Allen.

VII.—WILLOW CATKINS.

THE tall lithe sallows in the hedge beside the river are now all bursting out bravely into silvery catkins, some of them still covered by the silky down of early youth, and others yellow with the golden pollen of the maturer flowering season. Among them the bees are busy already; for you hardly ever see a willow catkin in full bloom without a bevy of its attendant fertilising insects. Unlike most other catkin-bearing trees, indeed, the willows depend entirely for the due setting of their seeds upon winged allies, and that is why their catkins stand so closely and stiffly set upon the branches, instead of hanging out loose and pendulous to the passing breeze, like those of the hazel, the birch, and the alder. There are no more curious flowers on earth than the little crowded blossoms of the catkin-bearers generally, and none among these themselves more singular and more highly developed than the willow kind. Let us begin by looking at the actual existing catkins of the sallow-bushes here, and then consider by what line of development they have reached their present strange condition.

The first thing one notices about the willow catkins is the fact that they consist of two kinds, growing apart from one another on separate bushes. The one kind, containing only female flowers, consists of silky-looking clusters; and when one pulls such a cluster to pieces, it turns out to be made up of single scales, each enclosing one small spindle-shaped ovary, from which are finally produced the familiar tufted cottony seeds, that fly about so abundantly through the air a little later in the season. Between this long ovary and the central common stalk of the catkin stands a little glistening, sticky gland—the nectary, in fact, whose honeyed secretion attracts the buzzing bees that flit so constantly about the flowering osier beds. The other, or male kind, consists of long cylindrical branches; and these branches, when similarly taken to pieces, disclose a number of other small scales, having two stamens concealed within each. Between these stamens and the stalk stands another sticky gland, just like that of the female flowers, to complete the attraction for the fertilising bees. In this very degenerate type of blossom, therefore, each flower is reduced either to a single pistil or to a pair of solitary stamens, covered only by a small concave bract or scale.

In order to understand how the willow flowers have ever reached such a stage of degradation as this we must trace the various downward steps by which their catkin-bearing allies have gradually lost all semblance of a perfect petaliferous blossom. The best point from which to start on our investigation is given us by the family of the elms and nettles, which are probably very close relations of the catkin-bearing trees. These plants have small flowers with four sepals or calyx-pieces in each, no petals, and four stamens. But we can easily see that they are descended from petal-bearing ancestors, because the stamens are placed opposite the sepals, instead of alternately with them; and we know that in perfect flowers each whorl or row of organs always alternates with the whorls within and without it. In fact, wherever we find abortive or monstrous petalless flowers, belonging to kinds which usually produce petals, they have their stamens thus opposite the calyx-pieces, instead of alternating with them. Hence we are justified in concluding that the elms and nettles, with their opposite stamens, are descended from ancestors which had bright-coloured corollas; but that the corollas have been lost through disuse, and have now left no token of their original presence, except this structural peculiarity in the modern flowers. The elms, indeed, have once more reverted to insect-fertilisation, and so their calyx has become bright pink in colour, and they also still retain a pistil and a set of stamens in every blossom—in other words, they are, as it is technically called, hermaphrodite. But the nettles, which are purely wind-fertilised, have gone a step further on the downward course, and have become unisexual; that is to say, each flower has either a pistil alone, or stamens alone, as is also the case in our willows here. Moreover, the grouping of the flowers of our common nettle in great loose bunches distinctly suggests the first beginnings of the catkin form. Such a loose arrangement of the male and female flowers in very mobile masses is, of course, peculiarly appropriate for wind-fertilised plants, as it enables the pollen to be shaken out easily by every breath of wind, and conveyed with safety to the spot where many sensitive surfaces are spread out at once for its due reception.

From the nettles to such early and regular catkin flowers as those of the alder is not a long or serious step. Here you see an alder branch in full bloom, with its long pendulous male catkins hanging pensile to the wind in graceful clusters. At first sight they look not unlike the male willow in their arrangement; but when you come to scan them closely, you see that under each hollow bract or scale there are not merely two stamens, as in our willow, but a little cluster of three tiny florets, exactly like those of the nettle, only on a smaller scale. Each floret contains four calyx-pieces, with four stamens opposite them; so that here again we get indirect evidence of the suppression of a former petal whorl. In the birch we find a further stage of degradation. The scale, or bract, now subserves all the purposes for which the calyx was originally intended; and as each bract covers and protects three distinct florets, there is now no special need for keeping the calyx-pieces separate, or for maintaining the individuality of the florets themselves. Accordingly, nature seems, to some extent, to have lost count, so to speak; there are still, as a rule, twelve stamens (making up the original three florets) under each bract; and there are also still, as a rule, twelve tiny sepals (making up the original three calyxes); but sometimes the number falls to ten, nine, or eight, and the sepals do not form a regular calxy, but lie about indiscriminately among the stamens. Even here, however, a sharp eye can yet detect the surviving traces of three distinct florets. In the hornbeam and hazel all trace of the calyx is lost; in other words, the tiny scales or sepals are now no longer produced, and we get only a lot of loose stamens included within a covering bract. Yet the hornbeam keeps up a very vague memory of the three primitive distinct florets, for it has usually about twelve stamens under each bract; while in the hazel, even this last trace of the three-fold arrangement has faded away, and the stamens are generally reduced to about eight. To the very end, however, the

stamens among most catkin-bearers tend to run in fours, eights, or twelves, as though you had always either one, two, or three florets under each bract.

All these trees are wind-fertilised, and in all, therefore, the catkins are more or less long and pendulous, while the traces of their original derivation from distinct and bright-coloured ancestors are well preserved in the series of changes throughout. But the willows are catkin-bearers which have found means to develop honey-glands, and to allure the spring bees as insect fertilisers to their sweet-scented flowers. Hence, not only are their bright golden or silky white clusters far more conspicuous and beautiful than those of any other group in the whole family, but they are also remarkable for their stiff, upright position, which, of course, is better adapted than the pendulous habit for their peculiar mode of fertilisation. Moreover, in the willows we finally lose sight altogether of the original arrangement by which three florets were congregated side by side under a single bract. In the male catkin of our sallows here, only two stamens are found within each scale, while in the purple willow the number is further reduced to one. This is quite what one might expect from their recurrence to the more economical method of insect-fertilisation, for plants which get their pollen conveyed in this safe and sure manner from head to head seldom need so large a number of stamens as those which depend entirely for the due setting of their seeds upon the wasteful and unconscious wind. However, even in this last and furthest development of the catkin-bearing type we are not left wholly without traces of the intermediate steps. For in the pretty almond willow, there are three stamens, and in the bay willow of northern England there are five; which leads us back directly to the oaks, with from six to twelve, and the beech, with from eight to a dozen. Thus, strange as it seems, each single scale of the common sallow, enclosing a pair of long stamens, is really the final degenerate descendant of three distinct and perfect petal-bearing flowers, subtended by a large enclosing bract. I know nowhere in nature a more admirable example of the way in which analogous or intermediate forms enable us to trace out the pedigree of a very abnormal or greatly altered type from wholly unlike and apparently unconnected ancestors.

A NEW TELEPHONE.

THE monopoly of telephone business acquired by the United Telephone Company (albeit at a very heavy cost for patents) has had that effect upon the commercial and scientific progress of telephony which usually attends such monopolies. A company with a huge capital finds, as a rule, little difficulty in overcoming its weak competitors, and as often as not it has the option of either buying or fighting them out of the market. Then, having the business in its own hands, it can charge its own price, and, generally speaking, conduct matters as it pleases. There is also to be observed a reluctance to adopt new forms of apparatus or machinery, preferring to progress, the saving which results from using up older and less perfect forms. One other consequence is that inventors, or would-be inventors, are oftener than otherwise discouraged, and so improvements which might possibly have proved to be great boons to the general body are lost, buried—may be for ages—in dense oblivion. This has, we fear, been our experience in matters telephonic. We have now, however, to chronicle the introduction of an instrument which, while it possesses the advantages of a Bell telephone, differs from it very materially, both in construction and principle, and threatens, therefore, if properly managed, to become a successful competitor of the older instrument. Even were it to do no more than bring down the price charged for the existing types, it will have accomplished a most valuable task.

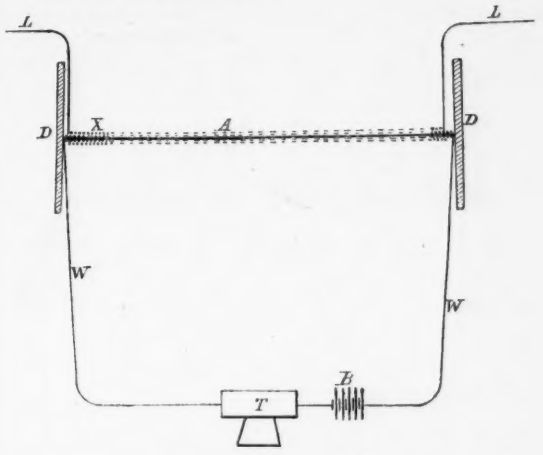

Fig. 1.

The general construction of this new telephone receiver may be gathered from the accompanying diagrams, of which Fig. 1 represents the more essential parts of the instrument, with its connections. The instrument consists of a thin wire, A, of iron, steel, or other magnetic metal attached to two discs, DD, which may be of thin wood, metal, or other more or less sonorous material; on the wire, A, is wound in the first place an insulated conducting wire, W, completing the circuit of a local battery, B, in which circuit may be introduced any known telephonic transmitting instrument, T; also on the wire, A, is wound in the second place an insulated wire, X, forming part of the line circuit, LL′, communicating with a distant station. When electrical impulses are set up in the line, LL′, at the distant station by a telephonic transmitter, sounds corresponding with those that caused the impulses are emitted by the instrument illustrated.

The principle involved here is easily understood. It is well known that when an iron wire or rod is magnetised, it suffers a slight increase in length, accompanied by a compensating decrease in its lateral dimensions or cross section. On the cessation of the current (or the removal of the inducing magnet) the iron returns to its latent magnetic condition, and a decrease in length results. This molecular effect is distinctly audible under favourable circumstances. Messrs. Alabaster, Gatehouse, & Kempe take advantage of this fact in the construction of their receiver. The current from the local battery, B, is continuous, and its effect upon the iron wire is, therefore, to make it practically a permanent magnet. When the current arrives from the distant station along the wire, LL′, it, in passing through the fine-wire coil, X, induces a current in the thick-wire coil, W, connected with the battery. The direction of the current induced in W varies, of course, with the current in the coil, X, and, accordingly, an increase or decrease in the strength of the battery current flowing through the coil, W, is produced, and the iron wire, A, is subjected to proportionately varying degrees of magnetisation. The minute contractions and elongations so produced in A necessarily cause corresponding vibrations in the attached wooden diaphragms, DD, which perform in this way the function of sounding-boards to A.

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The instrument may also be connected, as shown by Fig. 2, where the two discs, DD, form the ends of sound boxes, SS, having flexible tubes leading from them to funnel mouths, EE, that can be held to both ears. The

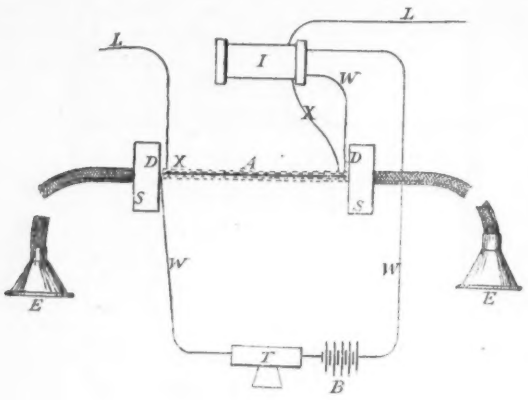

Fig. 2.

wire, W, may also include in its circuit the primary coil of an induction coil, I, the other wire, X, including in its circuit the secondary coil of I. The gain effected by using the induction coil is to increase the effect upon the local battery current.

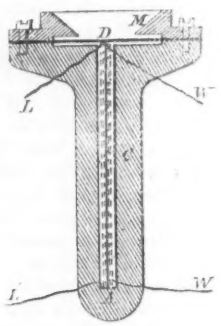

Fig. 3.

Fig. 3 shows a convenient form in which the instrument may be made. The iron wire, A, is, in this instance, enclosed in a wooden casing, C, to which one end of the wire may, or may not, be attached, the other end being attached to the single disc, D, which is clamped to the casing by an ear-piece, M. This form is very light, its total weight being no more than four ounces.

As regards the efficiency of the instrument, we may say that it reproduces the sounds with remarkable clearness, even in this, its crudest form; and when the transmitter (which we are not yet at liberty to describe), as well as a further improved form of receiver, are placed before the public, we imagine that the result will fully endorse our sanguine anticipations.

It is as well, perhaps, to mention that the inventors of the receiver we have described make no general claim to the use of an iron or steel wire coiled with a conducting wire for producing sounds under the influence of electric currents, but claim:—

"The construction of a telephonic receiving instrument consisting of a magnetic wire attached to a sonorous disc or plate, and wound with a primary coil connected to a local battery, and with a secondary coil connected to the telephonic line wire, as described."

PLEASANT HOURS WITH THE MICROSCOPE.

By Henry J. Slack, F.G.S., F.R.M.S.

A SACCHARINE fluid, intended for alcoholic fermentation, is liable, as brewers know to their cost, to turn sour, if, in addition to yeast ferments, there are also vinegar ferments present. Minute organisms, or germs of such, capable of acting upon alcohol and producing vinegar, are so widely diffused that it is only necessary to expose a suitable fluid to the air of ordinary places to be sure of their appearance in the course of time. A mere mixture of alcohol and water does not suffice for the growth of these organisms; but the addition of a little gluten, or some such substance, allows them to develop. A mixture of one part of sugar, six of water, one of brandy, or other strong alcoholic liquor, with a little yeast, put into a cask with the bung-hole open, and kept at a temperature of 70° or 80°, turns to vinegar in a month or six weeks, and a microscopic examination will show that besides yeast cells, others of a different character are present. The vinegar ferment grows much faster when a warm malt liquor is allowed to trickle over birch twigs, or shavings freely exposed to air. This is a well-known mode of vinegar making, and the twigs are soon covered with a coating of the ferment plants. When these ferments form a loose gelatinous deposit, it is called the "mother of vinegar;" but they may be obtained in another condition, called the vinegar plant, which is a very useful article in domestic economy.

As an instance of its formation, a case may be mentioned of a cask of apple-wine (apple-juice and sugar), which showed signs of sourness, and was therefore destined for vinegar. Several gallons were put into a large brown pan with some yeast, and loosely covered with a cloth, to keep out dust. It was left in a dark and rather cool cellar, below the temperature at which the acetification would proceed rapidly. In a few months there appeared floating on the liquid a dense, tough mass, like wet, buff leather, or a big slice of tripe, and the whole quantity of the fluid proved to be good vinegar, rather above the usual strength.

A vinegar plant is not a very easy thing to examine microscopically, which may account for its being erroneously described in some books. A modest power (100 to 150 ×) applied to a thin strip, shows groups of cells more or less resembling common yeast cells, and usually some sausage-shaped cells, with small cells inside them. The main mass is, not as has been said, a "structureless jelly," but densely crowded with small beaded cells, which give it a sort of wrinkled aspect under the magnification mentioned. To see more, a very small piece should be stretched and squeezed out, first with an old penknife — which the acid soon blunts — then by pressing on a slide with a thin covering glass. When partially dried and reduced to a film, a $\frac{1}{5}$th objective, or higher power if at hand, and careful illumination, shows that a minute portion must contain millions of extremely small beaded cells of the bacterium character. They appear most plainly when the objective is reduced by a stop to a moderate angle and the film is illuminated with Mr. Wenham's peculiar dark ground arrangement for high powers. This apparatus throws a beam of light at such an angle that it is totally reflected by the glass slide,

except at any spot where a new surface is made by the close adhesion to the glass of any refracting body. Many beaded structures seen in this way look smaller—nearer their true size—than they appear with an achromatic condenser and larger aperture.

A vinegar plant, then, is a compound organism, in which alcoholic ferments and acetous ferments live together in harmonious co-operation. The first convert the sugar into alcohol and carbonic acid, and the second oxidise the alcohol into vinegar, obtaining the oxygen from the air. The process may be a little more complicated, but this is the result.

When a vinegar plant has once been obtained, it is easily kept in a dark place in a jar with a little sugar and water. When fresh vinegar is to be made, it is placed in the fluid intended to be acetified in a warm cupboard. Between 60° and 70° is a sufficient temperature, and about six weeks the time required for two or three pints. At the end of the process the plant will be found greatly thickened, and it readily splits into two. The solution employed may vary according to taste. If pale vinegar, like that made from white wine, is required, good moist sugar and a little golden syrup treacle will do, with enough water to make a decidedly sweet, but not syrupy, solution. The vinegar obtained in this way smells like dilute acetic acid. The smell and flavour of common brown vinegar is produced if coarse brown sugar and darker treacle is used. When the process is finished, it is well to bring the vinegar rapidly near the boiling-point, to kill any ferments that may remain in it. Prolonged heating would dissipate the acetic acid, and must be avoided.

The vinegar plant seems to be a vegetable instance of what Van Benedon calls *commensalism*, the two sets of micro-ferments are fellow-boarders. Neither can be said to be a parasite upon the other, and it is probable that the minute acetic-ferments form the gelatinous mass in which the friends dwell like brothers in unity. A very small piece of an old plant is sufficient to start a new one; and it is an interesting experiment to put a bit the size of a pea into a two-ounce wide-mouthed bottle of clear glass, filled with a solution of lump sugar. The growth of the plant can then be easily watched with the help of a hand-magnifier, and the plant occasionally transferred to a shallow cell, and placed under the microscope. It will be found much more transparent than those developed in a brown sugar solution. The tendency of the growth is at first chiefly horizontal; but when it has reached the edges of the containing vessel, it thickens rapidly, if well supplied with food. While the fermentations are active, the plant floats; but when the sugar is exhausted, no fresh supply of carbonic acid buoys it up, and it falls to the bottom. When it is desired merely to preserve a plant for future action, it should be kept in a cool place, and moderately supplied with sugar solution, which should not be allowed to dry up, or the plant will be spoilt, and blue mould will grow.

"OUR BODIES:"

SHORT PAPERS ON PHYSIOLOGY.

By Dr. Andrew Wilson, F.R.S.E., &c.

No. VI.—THE TRUNK AND LIMBS.

THE *trunk* of the body (minus the *head* or skull, already described), consists of the spine, chest, and the "girdles" of the limbs. These "girdles" are the series of bones which attach the limbs to the trunk. Their composition we shall note presently.

The chest or *thorax* is formed by the spine and ribs behind, by the ribs at the sides, and by the ribs and their *cartilages* (or *gristly ends*), and breast-bone in front. The *ribs* number twelve pairs in man, and are attached behind to the twelve dorsal or back-vertebræ, each by a movable joint, which is utilised in the breathing movements. Occasionally thirteen pairs of ribs are developed in the human subject. The thirteenth pair in such a case is usually borne by the first lumbar vertebræ. Sometimes, however, we find a thirteenth rib attached to the seventh or last neck-vertebræ. These odd or extra ribs in man are, perhaps, best explained as survivals of the conditions of lower life, and as ancestral marks. The gorilla has normally thirteen pairs of ribs, and crocodiles have a whole series of neck-ribs. What is unusual in human anatomy, may thus be perfectly normal in lower existences. The first seven ribs are attached in front to the *sternum* or breast-bone each by a *rib cartilage*. Each *cartilage* is simply a bar of gristle, of highly elastic nature. We can see that with the front of the chest thus rendered elastic, the movements of breathing should be readily accomplished. In a crowd, our ribs are never so readily broken, if we meet the pressure from before backwards, so that the cartilages of the ribs act as buffers. If, on the contrary, the same pressure were applied at the sides of the chest, the ribs would most likely be fractured. The eighth, ninth, and tenth pairs of ribs are attached in front to the cartilage of the seventh rib. The eleventh and twelfth ribs are often called *floating ribs*—a bad name, because they do not "float" in anything. We should call them "free" ribs, and thus express the fact that they are short, and that whilst springing from the spine behind, they are not attached to anything in front. The *sternum*, or breast-bone, is a flat bone, shaped somewhat like a sword. It is broad above, and narrow below, where it ends in a piece of gristle. In old age, the cartilages of the ribs and breast-bone tend to become of bony nature. The ribs in old persons are thus more brittle and more readily broken than those of the young. Lime appears to be deposited in the rib cartilages in old age, and this fact, which is named a "degenerative process," is also represented in the bloodvessels as well as in the rib-cartilages.

The *limbs* in Vertebrate or "backboned" animals never exceed four in number. They are always developed in pairs, and always possess an internal bony axis or skeleton, to which the *muscles* of the limbs are attached. Vertebrate animals may have no limbs at all. Some fishes, *most* serpents (some snakes have small and rudimentary hind limbs), and a few lizards are limbless. Some fishes, such quadrupeds as the whales and sea-cows, and a few lizards have only one pair of limbs.

Each limb, as already noted, is joined to the body or *trunk* by a series of bones forming the *limb girdle*. If we take this *girdle* into account, we shall find a limb to be composed of *six* parts. The *upper* (or *fore*) limb is attached to the trunk by the *shoulder*-"girdle." In man, two bones form this "girdle." In a bird or reptile, we should find at least three distinct bones. One of these three bones, man possesses in a modified condition.

The *scapula*, or shoulder-blade, is the first of the two shoulder-bones. It is a triangular, flattened bone, lying on the back and upper part of the chest. Outside it has a strong ridge (the *spine* of the shoulder-blade) for the attachment of muscles. To the outer side, there are seen two prominent projections. The spine of the bone ends in one of these, the *acromion process*, and to this process the collar-bone of that side is attached. The other process is the *coracoid process*. This, in the bird or reptile, is a *distinct bone*, and forms, in fact, the chief support of the

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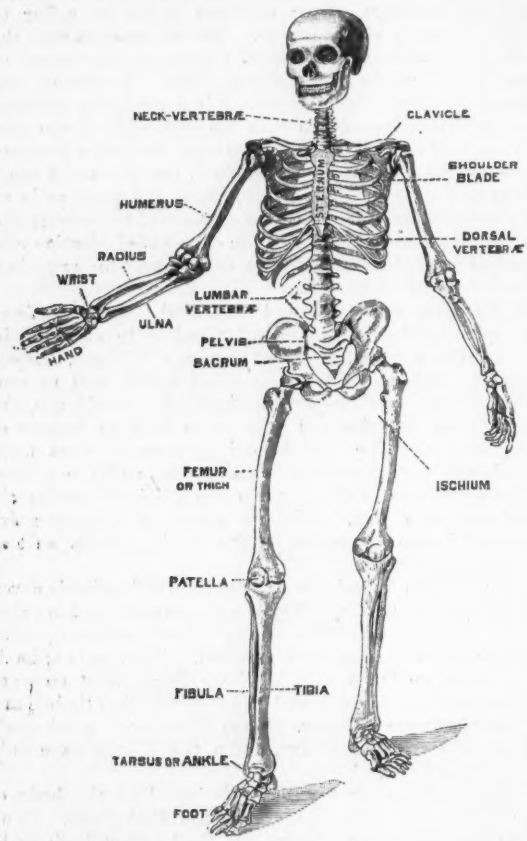
fore-limbs in these animals. The coracoid process overhangs a shallow, saucer-like space, called the *glenoid cavity*. Into this cavity the upper arm-bone (or *humerus*) fits, and thus forms the *shoulder-joint*.

The *clavicle* or *collar-bone* is the second of the shoulder-girdle bones. It is a narrow bone, shaped somewhat like the letter S. It rests by its inner end on the top of the breast-bone, and by its outer end is attached to the "acromion process" of the scapula. No collar-bones exist in hoofed animals (horse, cow, etc.), or in seals and whales. They are small in carnivorous animals, whilst bats, apes, and other animals possess them in perfect array.

The fore-limb of man consists (1) of a single bone, that of the upper arm, called the *humerus*; (2) of two bones forming the fore-arm, and called *radius* and *ulna*; (3) of eight small bones, forming the *carpus* or *wrist*; (4) of five



bones (one for each finger) forming the *palm* or *metacarpus*; and (5) of the five *digits* or *fingers*. The fingers, with the exception of the thumb, are composed of three small bones called *phalanges*. The thumb has only two phalanges (as one may see by looking at it), and there are, therefore, fourteen phalanges in each hand.

Holding the arm with the palm of the hand forwards or upwards (when the limb is said to be in *supination*), the *radius* is that bone in the fore-arm which lies to the thumb-side, the *ulna*, its neighbour bone, lying to the little-finger side of the limb. This is the natural position of these bones in man, and the bones lie parallel, as just described, and as seen in the right arm of the skeleton we have depicted. Now, turn the palm downwards or backwards. This action, of extreme utility to man, is popularly supposed to be effected by a "turn of the wrist." This is not the case. In turning the palm backwards or downwards, the *radius* runs round and crosses the *ulna*, so that in this changed posture (known as *pronation*), the relations of the bones are altered. The bones should, therefore, always be described naturally, with the palm forwards and with the radius and ulna lying parallel. It is interesting to note that in many animals (cat, dog, and carnivora generally; elephant, &c.), the *prone* position, with the radius crossing the ulna (as in the left arm of the skeleton depicted above), is the fixed and natural state of the fore-arm.

Five is the greatest number of fingers developed in mammals. They may diminish in number to four (in the dog), three (rhinoceros), two (in sheep, camel, &c.), or one (in the horse). The thumb may be wanting, as in spider-monkeys; and birds want the fourth and fifth fingers. In whales, the number of the *phalanges* (or small bones of the fingers) may be much increased from their numbers in man's digits. In the third finger of a species of whale, as many as fourteen phalanges are found.

The *lower* (or *hind*) *limb* is attached to a *girdle* familiarly named the *haunch*. This haunch, or *pelvis*, consists (1) of part of the spine (*sacrum*), already described, behind, and (2) of two haunch-bones or *innominate bones*, which are united in front. The sacrum is, in fact, firmly wedged in between the two haunch-bones behind.

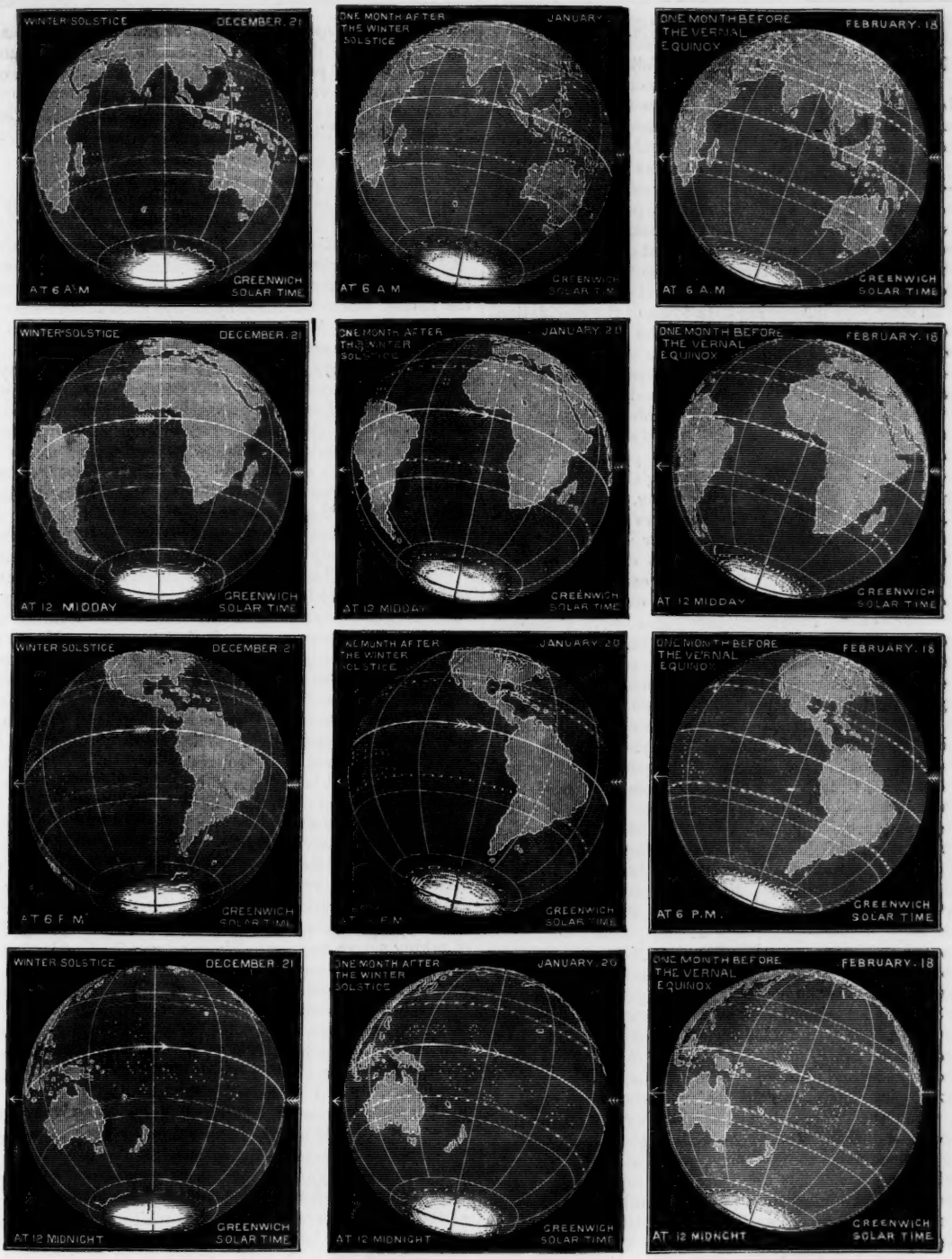
Each *innominate*, or *haunch-bone*, consists in reality of *three* bones. There is (1) the *ilium*, forming the expanded part of the haunch; (2) the *ischium*, upon which the body rests in sitting; and (3) the *pubis*, or front portion, which joins its neighbour of the opposite side. There is no trace in the adult of the threefold composition of the haunch-bones; but it is only about the twenty-fifth year of life that final union and firm ossification of the three bones take place. On the outer side of each haunch-bone is a deep cup. This is the *acetabulum*, in which the head of the thigh-bone rests to form the hip-joint.

The lower limb consists of (1) the *femur*, or thigh-bone, the longest bone in the body; which, below, joins (2) the leg, consisting of the *tibia* (or shin), which receives the lower end of the thigh-bone and the *fibula*, a long, slender bone lying to the *outside* of the leg; (3) the *tarsus*, or ankle, consisting of seven bones (one less than in the wrist; (4) the *metatarsus*, or "instep" and (5) the *digits*, or toes. The composition of the toes (of fourteen phalanges) is exactly that seen in the fingers.

There is a close correspondence to be noted between the skeleton of the fore and hind limbs. For we see that whilst humerus and thigh correspond, fore-arm and leg, wrist and ankle, and toes and fingers also show a marked resemblance. How these resemblances have arisen, is a difficult question to determine. Perhaps the shortest and safest fashion of solving it is to allege, what development seems to teach—namely, that the fore and hind limbs have been developed from a common type, and owe their divergences to the different uses which, in the economy of animal forms, they have come to subserve.

We must lastly note that the knee-cap, or *patella*, is not, properly speaking, a bone of the skeleton. It is not developed, as the other bones are, but is formed in the *tendon* or sinew of the great muscle of the front of the thigh. Such bones are called *sesamoid bones*. We find these bones developed in other situations, where the tendons or sinews exert great pressure on the parts over which they move.

The mileage of the passenger trains of the North-Eastern Railway Company during the last half of 1882 was 4,871,848; goods and mineral trains, 7,322,729.



SUN VIEWS OF THE EARTH;

OR, "THE SEASONS ILLUSTRATED."

By Richard A. Proctor.

I GIVE this week three sets of Sun Views, so that the gradual change of the earth's pose towards the sun as the year progresses may be as clearly seen as the change which takes place during a day's rotation. I propose to give each month, hereafter, to the end of the year, three such sets of views, dropping out a set each month, and bringing in a new set each month.

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SATURN'S RINGS.

THOSE of your readers who have followed the discussion in Knowledge on the chronology of discovery on the details of Saturn's Ring, will be interested in the valuable papers contributed by Professor Adams to the January number of the R. A. S. *Monthly Notices*. Like everything done by that most eminent mathematician, the essay before me contains internal evidence that the Lowndes Professor has spared neither pains nor trouble in his efforts to unearth the facts in connection with the subject under discussion in this case, that of Ball's claim—or rather the claim made for him—to be the discoverer of the duplicity of Saturn's Rings; and certainly he has contributed some very interesting data towards the elucidation of the question, mooted originally in the columns of the *Athenæum* by Mr. Lynn, and subsequently in these, in connection with this. I venture, however, to think that the matter is not even yet cleared up, and I propose, with your permission, to show why. Professor Adams in commencing his investigations rightly went to the fountain-head, and examined the MSS. preserved in the archives of the Royal Society. Among them he found a letter in William Ball's own handwriting, dated April 14, 1666, containing, *inter alia*, a reference to his observations of Saturn. In a postscript to this letter is a little sketch of the planet as it appeared at that date; and, says Professor Adams, "In this figure, the external boundary of the ring has the form of a regular oval, without any notches or other irregularities." Moreover, Professor Adams goes on to point out that the paper in the "Philosophical Transactions" was not written by Ball himself (this, however, is obvious, inasmuch as the entire paragraph is in the third person), and contains a quotation from a letter to a friend, who now seems to be almost certainly identified as Sir Robert Moray, and not Wallis, as erroneously stated by Breen. This quotation I repeat here in full:—"The author (Wm. Ball) saith in his letter to a friend, as follows: 'This appear'd to me the present figure of Saturn, somewhat otherwise than I expected, thinking it would have been decreasing, but I found it as full as ever, *and a little hollow above and below.*'" (The italics are mine.) Now, the original of this letter is not preserved in the Royal Society's collection, nor do they possess any drawing of the planet; but there is a paper cutting representing Saturn and its ring, as seen October 13, 1665, which Professor Adams believes to have been the original of the engraving which you reproduced on page 307 of your second volume. His theory of the notches is that the paper was folded twice in directions at right angles to each other, so that only a quadrant of the ellipse had to be cut; and that, while the cut started rightly in a direction perpendicular to the major axis, through want of care, when the cut reached the minor axis, its direction formed a slightly obtuse angle with that axis instead of being perpendicular to it. Thus, when the paper was unfolded, shallow notches or depressions appeared at the extremities of the minor axis. I am perfectly willing to concede that this affords a plausible and consistent explanation of the figure in the original plate in the "Philosophical Transactions"; but I confess that I do not place quite as much confidence in Professor Adams's suggested interpretation of the words I have italicised above, concerning which he says that he "cannot help thinking that this clause has been added or altered in some way to correspond with the given figure." Certainly, if we are to regard the preceding sentence as a verbatim quotation from a letter, there is nothing whatever in this one to indicate that it has been modified or altered in any way whatever. My chief end, however, will have been answered if I induce every one who has so far followed this description to consult Professor Adams's most interesting paper in the original. I may add, in conclusion, that he entirely repudiates any right or claim on Ball's part to have been the discoverer of the chief division in the Saturn's Ring.

William Noble.

CORPULENCE.*

(*Continued from p.* 87.)

THE waters of certain mineral springs, especially those of a cathartic nature, are sometimes employed with good results. They are generally more successful if taken at the spring, where the customs of the place favour exercise and plain diet. Waters that contain iodides are also recommended, but are of doubtful efficiency.

Another remedy, which seems less rational than any of the above, is recommended in the London journals, namely, the application of external pressure, whereby the dimensions of the body are gradually reduced to normal proportions. Several correspondents of these papers report that they have tried it with success, while no failures have yet been reported. One man, who had tried Bantingism without success, reports that "tight lacing" accomplished the desired result. Another gentleman reports that by the use of an ordinary lady's corset he reduced his circumference 8 inches (from 42 to 34 inches), with great improvement in bodily health. It is probable that tight lacing has a good effect on immoderate eaters, and thus favours leanness and (as some claim) cures dyspepsia, but we are unable to see how it can have any other good effect. Another remarkable fact is that men were the first to make the discovery that tight lacing will cure corpulence, while the other sex, who are supposed to have had more experience in the use of corsets, never found it out. While we do not wish to discredit the statements of so many witnesses, we cannot believe that tight lacing is a universal cure for corpulence, since it is well known that most corpulent women lace, some few of them excessively, and yet they are not cured of their chief infirmity thereby. Perhaps the effect is different on men, for, being unused to tight clothing, the corset proves a constant reminder of the necessity of exercising moderation in eating and drinking, while even the temporary reduction in size makes them more capable of taking active exercise. Since oxygen in the blood is essential to the consumption of the excess of carbon, whatever prevents free breathing should tend to increase corpulence; hence the corsets must not be worn too tight at first. With this restriction, the remedy is safe and worthy of a trial, when other means have failed, or wherever circumstances prevent the observance of Banting's rules. It is certainly safer than anti-fat nostrums.

Whatever course of treatment the man of Falstaffian proportions would adopt, failure is sure to result unless patience and perseverance are abundantly supplied.

In the case of anæmic corpulence, where the number of red blood corpuscles is insufficient to oxidize the elements of the food, the person will have a white, pasty, or doughy look. The cause being different, none of the above modes of treatment are applicable. The general health must be attended to, ferruginous tonics can be tried, and every means should be resorted to for oxygenating the blood. It is probable, even, that exposure to increased atmospheric pressure, as the workmen are in the Hudson River Tunnel, might be beneficial in such cases. Exercise, properly taken, is likewise beneficial. In general, however, such cases had better be referred to a competent physician.

* From the *Scientific American*.

WASTE OF THE WORLD'S FORESTS.*

WHEN the forests of such a country as Cyprus were destroyed, said Mr. Thistleton Dyer, in a discussion in the British Society of Arts, it was like a burned cinder. Many of the West Indian Islands are in much the same condition, and the rate with which the destruction takes place when once commenced is almost incredible. In the island of Mauritius, in 1835, about three-fourths of the soil was in the condition of primeval forest, viz., 300,000 acres; in 1879, the acreage of woods was reduced to 70,000; and in the next year, when an exact survey was made by an Indian forest officer, he stated that the only forest worth speaking about was 35,000 acres. Sir William Gregory says that in Ceylon, the eye, looking from the top of a mountain in the centre of the island, ranged in every direction over an unbroken extent of forest. Six years later the whole forest had disappeared. The denudation of the forests is accompanied by a deterioration in the soil; and the Rev. R. Abbay, who went to Ceylon on the eclipse expedition, calculated, from the percentage of solid matter in a stream, that one third of an inch per annum was being washed away from the cultivated surface of the island. In some colonies the timber was being destroyed at such a rate as would soon lead to economic difficulties. In Jamaica, nearly all the timber required for building purposes has already to be imported. In New Brunswick, the hemlock-spruce is rapidly disappearing, one manufacturer in Boiestown using the bark of one hundred thousand trees every year for tanning. In Demerara, one of the most important and valuable trees, the greenheart, is in a fair way of being exterminated. They actually cut down small saplings to make rollers on which to roll the large trunks. In New Zealand, Captain Walker says he fears that the present generation will see the extermination of the Kauri pine, one of the most important trees. All these facts show that this is a most urgent question, which at no distant date will have to be vigorously dealt with.

EVOLUTION OF LIFE.†

THERE is a difficulty in commenting here on the work of one who appears so often in these pages, because any commendation of such work reads as indirect praise of Knowledge. Yet we feel that we ought not on that account to pass over such treatises as those which Mr. Grant Allen and Dr. Wilson have recently produced. In particular, such a work as Dr. Wilson's "Chapters on Evolution," presenting in every page evidence of careful labour, crowded with interesting matter, and relating to a subject about which every man of sense and intelligence wishes to be well informed, is one which ought to receive the notice which it well deserves.

There can be no doubt that the modern theory of biological evolution is greatly misunderstood by that rather mysterious abstraction—the general reader. Perhaps this has been because so much nonsense has been written about it, as well by those who wish to believe in it, but know very little about it, as by those who reject it, and know nothing. Quite early, the tendency of the theory was seen to be towards the widest possible generality. It was recognised that man could not possibly be excluded from the law of evolution. Those who had believed in his nobler origin from the dust of the earth were pained. They objected to a doctrine, according to which man, instead of having been made originally a little lower than the angels, had risen from only a little higher than the beasts of the field,—instead of being made in the likeness of God, must be regarded rather as having imagined God after his own likeness. It is true the new doctrine presented man as having risen—and likely, therefore, to rise still higher—while the old presented him as having fallen grievously, having, from being next door to an angel, and quite in the likeness of God (though, for a slight temptation, or none, held out by an objectionable reptile, he so offended as to merit death—not, before, a part of the plan), he had become a wretched creature, "deceitful above all things, and desperately wicked." So that, on the whole, the new teaching was a more cheerful one, apart from religious hopes and fears,—which do not belong to our inquiry here. In a scientific sense, too, the new doctrine about the origin of man seemed to accord somewhat better with the evidence than the old. It had always seemed a little difficult to understand, or even to conceive, the formation of man out of dust; his formation out of nothing would have been a comparatively simple matter; but that something should be necessary, and that something dust, had been perplexing. So had the origin of woman—speaking always in the scientific sense. And again, the possible existence of animal life, either in human beings or in the beasts of the field, for ever, had troubled the students of physiology, who found it not readily conceivable. The new doctrine, indeed, was not without its difficulties. It gave no account of the beginning of life on the earth or anywhere else. It carried back our thoughts over infinite time—or time, to us, practically infinite; for no mind can conceive such a period as a million years, and the new doctrine recognised tens of millions of years. It was as impressive in regard to time as the teachings of astronomy with regard to space. It presented the domain of uniform law as infinite in time, so far as our conceptions are concerned. And somehow many who had looked with complacency at the existence of development in limited regions of space and over short periods of time—had even, in these, found evidence of the goodness of the laws of nature—were pained, almost horrified, at the evidence of the perfection of those laws afforded by their fitness to reign throughout practically infinite space, and during a practical eternity of time. As men had erred in their estimate of space, mistaking a point for the universe; as they had erred in mistaking a mere instant for all time; so, it seemed, they had utterly underestimated the range, in space and time, of the uniform operations of nature. Many objected to this introduction of infinity from the scientific side. It was so much easier to understand a little tract of earth and water, with the heavens arched overhead, the sun, moon, and stars set in them for signs, and everything set going in a short time, and set right at short intervals. Only, unfortunately, the earth's crust and the host of heaven alike tell a story inconsistent with this convenient narrowing of God's domain in space and time.

We doubtless owe to the natural pain and grief with which the new doctrine was received, the wild ideas which were associated with it, and are still rife. The absurdities quoted at page 104, from Mr. De Witt Talmage's foolish sermon, though, of course, an exaggeration of the nonsensical ideas commonly entertained about evolution, afford a fair sample of their nature. There is a picture—a great favourite with anti-development lecturers—which fairly illustrates the supposed nature of the rival theories. It is called "Our First Parents"; on one side a statuesque Adam and Eve (without the serpent, and looking as though forbidden fruit would be quite safe with them), on

* From the *Popular Science Monthly*.

† "Chapters on Evolution." By Dr. Andrew Wilson, Author of "Leisure Time Studies," &c. With 237 Illustrations. (Chatto & Windus, London.)

the other two monkeys which the artist has tried, though vainly, to picture with an expression as evil as that familiar to those who have ever had occasion to pass through St. Giles's or the Bowery, or certain quarters of Paris, Vienna, San Francisco, Melbourne, Sydney, and other large cities. If our first parents had been represented by two handsful of dust on the one hand, and by Infinite Space and Infinite Time on the other, the comparison would have been nearer the truth.

But when we turn from the follies which have been uttered about that particular part of the doctrine of evolution which we owe to Darwin, to consider the grave and well-weighed utterances of the student of biology, the vanity of the dust and uproar raised by the opponents of the general doctrine over this particular point is clearly recognised. The specific objections of an Owen, or an Agassiz, or a Mivart, which leave the general doctrine untouched, do not concern us in this respect. They relate to the way in which evolution took place, not to the fact of evolution; they concern the extent to which the struggle for life has affected development, not its existence as a factor in biological evolution.

Consider the following propositions, on which Darwin's theory rests, which we abridge from Dr. Wilson's treatise, and note how little open to doubt is each one of them :—

1. No two individuals of any species of plants or of animals is alike, none conform *exactly* to a normal form of the species.

2. These variations, by natural laws of inheritance, may be, and are, transmitted to the offspring.

3. More animals and plants are produced than can possibly survive. Each, if its natural increase were unchecked, would alone suffice to fill the whole earth in a few thousand years at the outside.

4. The conditions under which animals live are continually undergoing physical change.

5. Since all cannot live, there must be an endless struggle for life, in which, *on the average*, the fittest will prosper best; and, as the physical conditions are ever changing,

6. The variations named in 1 come into play, those which tend to increase the fitness of a species being encouraged, so that

7. New varieties are produced, which in time form new races, and these in time new species.

8. Past time (in the earth's history) has been, to all intents and purposes, *infinite*—so that *probably* all the existent species have had their origin in evolution from a few simple forms.

Yet hundreds of thousands of years ago the variety of life on this earth may not have been very much less than now. We may even look back to an exceedingly remote time when the earth's condition was changing much more rapidly than it does now, for the time when the chief work of the differentiation of species was brought about; nor is it wholly improbable that at a remote epoch in the earth's past history those sudden variations which now occur but seldom (as in the case of the Ancon sheep, &c.), may have been frequent, and so new varieties, races, and species may have been formed in shorter periods of time than now.

Sexual selection would also have its influence in modifying races, and forms an important part of the modern theory of biological evolution.

Dr. Wilson goes carefully and in a most instructive manner through the general evidence on which the modern theory of biological evolution is based. We can imagine few who can either fail to understand his clear account, or fail to be satisfied by the overwhelming weight of evidence. One feels that an effort such as is made by certain well-meaning persons to reject the evidence of nature in this respect is not merely offering to God the unclean sacrifice of untruth, but involves the belief that His works are themselves untruthful, since these works teach the lesson of evolution so distinctly.

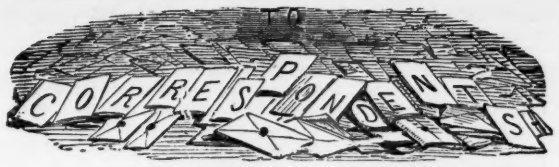
In the earlier chapters Dr. Wilson explains the methods in which biological studies are pursued, the constitution of the animal and plant worlds, and the relations of protoplasm to life. He then discusses the evidence derived from rudimentary organs, from the gradual modifications of animal structure, from likenesses, and from "found links" (which involves the explanation of "missing links"). The ninth, tenth, and eleventh chapters deal with the evidence from development, giving much space (though he might have given more, could he have afforded it) to the deductions from the embryology of vertebrates. He shows but briefly—yet the evidence is conclusive enough—that, *whatever the meaning of the fact may be*, man's development is but an epitome of that of lower forms of life. The twelfth chapter, dealing with that strangely fascinating subject, the metamorphosis of insects, is full of interest. The other chapters discuss the evidence from the constitution of compound animals, the fertilisation of flowers, the evidence from degeneration (an essential part of the theory of development); and lastly, the relations of geology to biological evolution.

The work is sound and thorough, as well as interesting. Though not a small book, it may be regarded as an abridgment of the multitudinous evidence on which the modern theory of the evolution of various races and species depends.

The electric light has been adopted by M. Lazare Weiller, manufacturer of phosphor and silicious bronze telephone and telegraph wires, at his extensive works at Angoulême. It is stated that the price of gas there is about 8s. 4d. per 1,000 ft., and to produce a total luminosity of 515 carcels (nearly 5,000 candles) would cost 2·6677 francs (25·63 pence) hourly. Instead of gas, five Gramme arc lamps and fifteen Swan incandescent lamps are used, at an estimated total cost of 1·21 francs (11·61 pence) per hour. A saving of 1·46 francs per hour is thus effected. The total cost of the installation was 6,215 francs (£248·6), not reckoning about 1,000 francs for fixing, belting, &c. This would be more than made good in three years' working at 2,400 hours per annum. M. Weiller, therefore, consulted his best interests in thus adopting a light which, while it performs its functions much better than gas, is considerably cheaper.

The Westminster Aquarium Electric Light Exhibition promises to be the most complete yet held. It has been very slow in starting, the opening having been several times postponed. We wish it every success.

Some remarkable archæological discoveries have recently been made at Mitla, a village in Mexico, situate between twenty and thirty miles from Oajaca, in the table-land of Mixtecapan. Extensive remains of ancient palaces and tombs have been revealed, and it is stated that they are exceptionally remarkable from the columns supporting the roof, a style of architecture peculiar to the district of Mexico in which they have been found. These ruins have been explored and photographed by Herr Hemil Herbruger, who states that the great hall contains six columns, and is 37 mètres long by 7 broad. Each column is 37½ mètres in height, and is of solid stone.—*Engineer.*



"Let Knowledge grow from more to more."—Alfred Tennyson.

Letters to the Editor.

Only a small proportion of Letters received can possibly be inserted. Correspondents must not be offended, therefore, should their letters not appear.

All Editorial communications should be addressed to the Editor of Knowledge; *all Business communications to the* Publishers, *at the Office, 74, Great Queen-street, W.C.* If this is not attended to, delays arise for which the Editor is not responsible.

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SPRINGS AND STREAMS.

[727]—Having made a large number of observations on the phenomenon of springs, I hope to be able to throw a little light on "Zeta's" inquiries.

1. I have not found that springs are affected by the direction of the wind, but I have found that their rise and fall is coincident with that of the mercury in the barometer, only in opposite directions, that is, with a falling barometer a strengthening spring, and vice-versâ.

2. "Quick rise after low, foretells stronger blow," and also frequently rain. In the case of a spring the order is reversed.

3. If springs continue to fall after heavy rain, it shows that the rain has not percolated to the water-line, but that that part of the rainfall which has not gone off by evaporation has been retained in the strata lying above the line of saturation, by capillary or other attraction.

In order that the foregoing remarks might be better understood, let us take a walk in a southerly direction from the Thames, selecting a valley—say that of the Wandle. We pass over London clay of considerable thickness, and about three miles from the Thames find a number of artesian wells, the water from which is obtained by boring through the lower eocene formations, into the chalk, when the water rises to the surface and continuously overflows; indeed, in one case the water may be seen flowing from the mouth of the iron pipe—with which the well is lined—at a height of ten feet above the ground-level, its fall being utilized in turning a small wheel used for grinding purposes.

Careful observations in a well of this description show that the flow is immediately affected by the atmospheric pressure, a fall of one inch in the mercury being accompanied by an increase of about 5 per cent. in the flow of the spring.

Continuing our walk southwards, we soon arrive at the foot of the Surrey hills, where numerous beautiful springs are thrown out at the contact of the Thanet sands with the chalk, where the point of contact lies low. The water does not, however, rise in a vertical direction, but moves forward in a nearly horizontal plane from the main body of the chalk. Let us continue our walk up the hill, measuring the depth to the water in all wells met with; and also with an aneroid, note the level of the mouth of the well. On our return we plot a section of the ground passed over, and mark in the wells with the water-line. The chalk above this line is partially, and that below thoroughly, saturated. Above the line, the water particles move downwards perpendicularly; below, the water moves forward slowly to the point where it re-appears as a spring, after years of disappearance since it fell as rain; part, however, passes under the London clay and re-appears lower down the valley in the shape of an artesian well (overflowing well would be more exact).

It is the water lying above the point of saturation that is affected by the atmospheric pressure, and from which the water below the line of saturation receives an accession, even at times when there is no rain; with a rise in the water-line, there is also an increase in the flow of the springs, and vice-versâ.

There is ordinarily a great pulsation of the water-line annually; the rise due to the autumn rains commencing about Christmas, and attaining its maximum about Midsummer, the fall being from that time to Christmas. The periods of rise and fall will, of course, depend mainly on the time and nature of the rainfall, but that given is as a broad rule correct. ("When the days begin to lengthen, the springs begin to strengthen.") This is the reason why deep-seated springs are often stronger in summer than in winter.

A number of subsidiary pulsations in the water-line, however, occur, due, as before stated, to the variations in the atmospheric pressure. Why this should be so, however, is more difficult to discover. Take the case of a well on a chalk hill, where we measure down 200 ft. to the water-line. If we take a column of chalk from its side one foot square, and extending from the top to 10 ft. below the water-line, we have 200 cubic feet partially, and 10 ft. totally saturated. In the latter case, the volume of water contained in one foot of chalk will be about two gallons, while in the latter it varies, but I have found damp chalk, that is, partially saturated chalk only, to contain 1½ gallons per cubic foot. In our column, then, we have $200 \times 1\frac{1}{2} = 300$ gallons, or an ample supply from which that below can be replenished if suitable means be adopted. Nature's means are the rise and fall of the atmospheric pressure, although, as I unfortunately do not possess an air-pump, I am unable to state the exact way in which this is accomplished.

Incidentally the rain-fall is about 30 in. per annum in our case, two-thirds of which do not become absorbed by the chalk, but are lost by evaporation, and by being taken up by plants, &c. It would take fifty-eight years, therefore, merely to partially saturate our column. How long, therefore, does it take the rain falling to-day to reach the water-line, although its effect might be seen a few weeks hence only? Chalk.

[728]—In the Tenth Annual Report of the Commissioners of Inland Fisheries, U.S.A., page 64, is the following (1869):—In the autumn of 1868, the Commissioners established a small hatching house at Maple Spring, in Wareham. Daily observations of the temperature of water and air were recorded, and there appeared thence a fact which seems never to have been explained, namely, that the temperature of spring water falls before a storm without regard to the rise or fall of the surrounding air. Thus on Nov. 20, 1868, the air rose 1° and the water fell 5°. This fall was immediately followed by the greatest gale of the year. Similar phenomena were noted both in 1868 and 1867. C. W. Harding.

TELESCOPES AND MICROSCOPES.

[729]—In Knowledge (Jan. 13, 1883, p. 28), in an article by Mr. T. Foster, on Mercury, I read this passage:—"I have seen it stated—nay, proved, if the writer who made the statement can be trusted—that the ancient Assyrian astronomers knew all about the rings of Saturn, the four moons of Jupiter, and other astronomical wonders which only the telescope could have revealed to them." What evidence, may I ask, is there that any ancient people possessed artificial means of assisting natural vision? I have always thought there must have been some scientific aids, but I never heard of any glass lens—imperishable as glass is—or other object having been discovered in the *débris* of the past, that could have answered any such purpose. It seems incredible that the Assyrians, the Indians, the Arabians, the Egyptians—to say nothing of the Greeks, their pupils—should have made the observations of the heavens they did without artificial, that is, scientific, aid. Ennius, according to Cicero, puts into the mouth of Iphigenia the following speech to reproach Achilles with his superstition and cruelty:—

"Astrologorum signa in cœlo quærit obscurat Jovis,
Cum capra aut nepa aut exoritur nomen aliquid belluarum.
Quod est ante pedes, nemo spectat, cœli scrutantur plagas,"

and Socrates, according to Plato, used to tell a story of Thales tumbling into a well whilst studying the stars.

Now, although I by no means say that poets are the best historians or astronomers, it is plain the starry heavens were eagerly scanned, and strange animals discovered or fancied. How? The modern telescope, if I mistake not, is attributed to Jansen, who lived in the sixteenth century, and it was brought into notice by Galileo, who got into trouble by seeing further with it than the priests of his church could.

Now as to the microscope, "quod est ante pedes, nemo spectat" is not quite correct, for it is plain Epicurus and the Greek philosophers examined primordial atoms with a searching, critical eye:—

"Sunt igitur solida primordia simplicitate,
Quæ minimis stipata cohærent partibus arcte," &c., &c.

(Lucr. de Rerum Nat. I., 603); and if it be again objected that poetry is no proof, Pliny senior, a little later, must have examined nature pretty closely and (excuse me) prosily. But how? Without artificial assistance? The invention of the microscope, like the

XUM

telescope, is, I believe, imputed to Jansen, and was not known till the end of the sixteenth century. Lord Bacon, in the "Advancement of Learning," published in 1605, speaks of it as a novel invention, and likely to assist in the investigation of the minute and infinitesimal objects of nature, as, in fact, it is now doing. But my puzzle is, how did the ancient people of the earth do without these aids? or what evidence is there they possessed them? Can KNOWLEDGE inform us? G. G. HARDINGHAM.

[I believe Mr. Foster refers to the Essay on Chaldean Astronomy forming the First Appendix of my treatise on Saturn. Mention is there made of a plano-convex lens discovered at Nimroud by Layard, and giving a tolerably distinct focus at 4½ inches.—R. P.]

A THEORY OF ATMOSPHERES.

[730]—1. It is convenient to consider any atmosphere round a body like the earth or sun as divided into two halves of equal weight, the lower half resting on the surface of the body, under the pressure of the upper half. It will be assumed that the gaseous laws of volume pressure and temperature hold good, and that the molecular theory is true.

2. If the total quantity of a given atmosphere is increased or lessened, other things being the same, the density of the lower half will be greater or less, but its volume, and therefore its height, will not be altered. For twice the quantity in the lower half will be under twice the pressure from the upper half.

3. If another gas with a different relative weight be substituted, the height of the lower half will be inversely as the relative weight—for the volume is so, other things being the same.

4. If the force of gravity be different, the height of the lower half will be inversely as that force—for the pressure is as the force of gravity.

5. If the temperature varies, the height of the lower half will be directly as the absolute temperature.

6. When the gas is air, with relative weight 14·45, the acceleration of gravity 32·2 feet in a second, and the temperature 0° Cent., the height of the lower half atmosphere is 3·44 miles, by Maxwell's formula, which agrees with observation. It follows that for any gaseous atmosphere round a spherical body,—

$$\frac{14{\cdot}45}{W} \times \frac{32{\cdot}2}{G} \times \frac{T}{273} \times 3{\cdot}44 = \frac{5{\cdot}86\,T}{WG} = H$$

W being the relative weight of the gas (hydrogen = 1).
G, gravity in feet per second.
T, absolute temperature in degrees Centigrade.
H, height of lower half of atmosphere in miles.

7. The height of the upper half is indefinite, but its density at any height is in known relation to the density at the bottom, the gaseous laws holding good. At twenty times the height of the lower half, the density is reduced to about one-millionth; at forty times to one-billionth. These are maximum densities at those heights, unless the temperature above is greater than below. And any substance of any probable density becomes inappreciable when the density is reduced to one-billionth. It follows that $\frac{5{\cdot}86\,T}{WG} \times 40$ = the extreme height to which any appreciable atmosphere can be supposed to extend in miles.

8. On this theory, if the sun has an atmosphere of hydrogen above the photosphere, its greatest height would be—

at T = 0° Cent., 72 miles,
at T = 27,300° Cent., 7,200 miles,
at T = 273,000° Cent., 72,000 miles.

If a layer of hydrogen, resting on the photosphere, vanished at a height of 5,000 miles, it would indicate a temperature of about 20,000° Cent.

If the sun has an atmosphere appreciable at a height of one million miles, the temperature not exceeding 20,000° Cent., the gas composing it, on the theory, must be at least 200 times lighter than hydrogen.

9. The height of the lower half of any atmosphere, on the above theory, is nearly equal to half the height to which the mean molecular velocity of the gas, at the mean temperature, would carry a projectile upwards against gravity from the surface of the attracting sphere. For it is so in the case of the earth's atmosphere, and the relation must be constant, because the projectile height is as the square of the velocity; and the square of the mean molecular velocity is, like the height of the half atmosphere, inversely as the relative weight of the gas and directly as the absolute temperature.

The square of the molecular velocity of air, as determined dynamically, at 0° Cent. is 2,526,000 feet per second.

$$\frac{2{,}526{,}000}{2G = 64{\cdot}4} = \text{projectile height} = 39{,}200 \text{ feet},$$

the half of which = 3·71 miles. The difference between this and the estimated height, 3·44 miles, is not more than may be due to errors in the fundamental data. But the reason for this particular relation is not apparent.

10. The decrease in gravity and temperature, and the increase in superficial area in ascending, are not considered above. The height of the lower half atmosphere is little affected by them, but that of the upper half is increased by the first and decreased by the second and third; and the effects of great disturbance by explosive or other forces, as, for example, in the sun's atmosphere, have to be considered separately.

The assumption that no atmosphere is appreciable when reduced to one-billionth of its density at the bottom is arbitrary, but the limits of probable error from this source are not very wide. For the reduction is carried to the million-billionth at a height of sixty, and to the trillionth at that of eighty half atmospheres.

The final results are necessarily approximations only.

ALBERT J. MOTT.

WEATHER FORECASTS.

[731]—Sir E. Beckett's communication on weather forecasts, which you have reprinted from the *Times*, deserves some notice. I reside in a district (the north of Ireland) in which, for reasons well known to all meteorologists, the forecasts are much less likely to prove accurate than those for the S.E. of England. Some months ago it appeared to me that the Irish forecasts might be made much more accurate, if the proper parties could be induced to meet the needful expense, and, as a preliminary step, I set myself to carefully note the forecasts and their fulfilment under the existing arrangements. I am now, therefore, able to subjoin an analysis of the forecasts for the last four months of 1882 for this district. Space will not permit me to follow Sir E. Beckett's method of giving each day in full, therefore the course I adopt is this. I have records for 88 days; the forecasts which have turned out quite correct I numbered 1. There were 34 of these, or equal to 38½ per cent. Those which were only partially correct I numbered 2, which occurred on 33 days, or 37½ per cent. Those which were in great degree a failure I numbered 3 on 11 days, or 12½ per cent. No. 4, or total failures, were on 10 days, or 11½ per cent.

Applying the same mode of analysis to the 24 days given by Sir E. Beckett, I find a less favourable result. No. 1, according to my valuation, occurred five times, or only 21 per cent. No. 2, nine times, or 37 per cent. No. 3, four times, or 17 per cent.; and No. 4, six times, or 25 per cent. Of course, in making an analysis like the above, where one has to deal with somewhat indefinite terms, such as hot, cold, showery, fine, &c., &c., a great allowance has to be made for the "personal equation" of the observer, but allowing for that, it still appears to me that during the month chosen by Sir E. Beckett, the forecasts were less successful than usual, and are therefore hardly fair to the Department. The value of the forecasts is very different to different people, and I believe many who, like myself, have a little knowledge, though quite elementary, of meteorology, they have been of great service. For my own part I should be very sorry to see them discontinued, and would prefer that our efforts should be directed towards making them more reliable, and therefore more useful, than in pooh-poohing them altogether. F. W. LOCKWOOD, Hon. Sec., B.N.F.C.

THE GREAT COMET—MAGNETIC STORM.

[732]—The Great Comet is still visible here to the naked eye in Canis Major. The tail, traceable for ten or twelve degrees, is of about half the luminosity of the "Clouds of Magellan."

On the night of January 8, from observations taken at the Imperial Observatory, it was noticed that the nucleus presented an elongated appearance, which was not the case on the previous evening. With powers of 500 and 600, it was not only much elongated, but subdivided into four small nebulosities, three of which presented the appearance at the centres of stars of the twelfth magnitude. In comparison with the others, the fourth appeared less condensed, but a little more elongated.

The observations were continued throughout the night, till one o'clock a.m. (Rio de Janeiro time), when they were brought to an abrupt termination by light cirrus, during which time no alteration was discernible, but the four nuclei maintained their same relative positions and aspects. The magnetic storm of November was severely felt throughout the South American Continent, though unaccompanied by the miracles which somehow have such an affinity for our cousins of the stars and stripes.

Rio de Janeiro, Jan. 10. T. H. D.

STORED ENERGY.

[733]—The following question may perhaps interest some of your chemical readers, although I am not sure that it is original.

If two exactly similar watch-springs, one coiled and the other not, be dissolved in an acid—the action taking place uniformly, so that the first spring does not uncoil—will more heat be evolved in the first than in the second case? If not, what becomes of the energy stored up in coiling? STUDENT.

[The times in which the coiled and uncoiled springs are dissolved will not be equal.—R. P.]

LOGICAL PUZZLE.

[734]—To those who are familar with Professor Jevons' "Logical Alphabet," it seems perfectly simple to deal with the "Logical Puzzle" now under discussion in KNOWLEDGE.

Thus, when we combine three terms, *X*, *Y*, and *Z* (not *X*, not *Y*, not *Z*, being denoted by *x*, *y*, and *z* respectively), we have the eight possible combinations:—

1. *X Y Z* 3. *X y Z* 5. *x Y Z* 7. *x y Z*
2. *X Y z* 4. *X y z* 6. *x Y z* 8. *x y z*

unless it can be shown that there is in existence some law which contradicts one or more of these.

Now, the premises in this case do not contradict any of them, and the burden of proof lies with those who would contradict the conclusion.

For the Alphabet, see Professor Jevons' "Principles of Science," a treatise on logic of scientific method, second edition, p. 94.

FREDK. BINYON.

[Hence recognise the value of logic! Consider that in every possible case of the syllogism the conclusion is obvious: so that, while the trained logician is carefully determining under what form the case would be classified, a clear-minded thinker has formed his conclusion, and gone a long way on with something else.—R. P.]

SOME ELECTRICAL ANSWERS.

[Space cannot hereafter be spared for answers to individual querists.—ED.]

[735]—J. C. L. M. Both springs should touch. The more iron you have in your magnets, the higher will be their capacity for magnetisation. Your one object should be to get a strong magnetic field. So long as you attend to this, the shape is immaterial. Why not bend two strips one over the other to form a thick magnet?—L. B. The sand battery is useless for intensity coils. As you object to the Bunsen cell, try the double liquid bichromate.—Geo. Allbeury wants to know how lightning protectors are fixed to church steeples, &c., without the use of scaffolding. I have seen a modern "Steeple Jack" at similar work. He flew a kite over the steeple, the thread lodging on the top. This thread was then used to pull a larger one, and so on until a stout rope was passed up the face of the steeple over the top and down the opposite face. It was then secured, and the man, hoisting himself up, executed his work.—J. H. WARD. 1. Yes, certainly. It would then be a Bunsen cell. Blocks are used in preference to plates, because they are cheaper. They are cheaper because they are more easily obtained. It is no disadvantage to have the platinum in the Grove cell thin, as it is not chemically affected. 2. Instead of the secondary layers gradually *increasing* in length, they should rather *decrease*. This extra wire is so much resistance inserted without any compensating gain. Maybe your insulation between the primary and secondary is imperfect. Join one end of your secondary to one pole of the battery, and one end of the primary through as sensitive a galvanometer (wound with fine wire) as you can secure. If you get the slightest movement of the needle, your insulation is at fault. You ought with four good Bunsen cells to get a spark of 2 in. or 3 in.

TRAVELLERS' METEOROLOGICAL EQUIPMENT.—The Council of the Meteorological Society announce that they have determined upon holding at the Institution of Civil Engineers, 25, Great George-street, S.W., on the evening of March 21 next, an exhibition of meteorological instruments which have been designed for, or used by, travellers and explorers. The committee will, they state, also be glad to show any new meteorological apparatus invented or first constructed since last March, as well as photographs and drawings possessing meteorological interest.

GAS *v.* ELECTRICITY.—At the half-yearly meeting of the shareholders of the Gas Light and Coke Company (Limited), held last week, the chairman admitted that he was no prophet, and therefore abstained from making any remark on the future of the electric light. While assuring his hearers that there was no ground for apprehension, he acknowledged that he does not look to illuminating so much as to the cooking purposes of gas to compensate the company for any loss they may sustain from the electric light. [This is somewhat different language from that hitherto adopted at gas companies' meetings. It is nevertheless the most truthful.]

Our Whist Column.

By "Five of Clubs."

THE GAME ON PAGE 77, No. 66.

REFERRING to the remarkable game at page 77, XXXVIII. of Cavendish's selected games, the following passage from that writer's late book will be found interesting:—

"Of course, I seldom played at the same table with my father at the Portland," writes Cavendish. "But it occasionally happened that there was only one table, and that we must either play together or lose our amusement. On one of those afternoons I was *Z* in Hand No. XXXVIII., and my father was *B*. By reference to the game" (KNOWLEDGE, p. 77) "it will be seen that I played the *grand coup* against him. My partner was a very good player. When the game was over the following conversation took place:—

"*K.* (my partner, to me).—'You trumped my best diamond.'

"*Ego.*—'I know I did. We won the trick by it.'

"*K.*—'I don't see how you could win a trick by trumping a winning card.'

"I should mention that my father had seen the position as well as I had, that he knew I had three trumps (as was clear after my discard at Trick 8), and that he was waiting to be led to in trumps. I noticed, too, from his manner, that he hardly knew whether to feel pleased at my good play, or annoyed at being outmanœuvred.'

"*Ego* (to *K.*).—'Ask "the governor" if we didn't.'

"*Pater* (gruffly).—'Of course you did, of course you did.'

"I afterwards told Clay of this *coup*, and he was good enough to say that he admired the discard of the King of Spades at Trick 8. He also chaffed the 'governor' a bit about my unfilial conduct."

Note.—Our remark on trick 9, that "it matters not which" trick of the 10th and 11th *Z* wins, he would lose, is incorrect. If he had let *Y* make the 9th trick, discarding the Club ten, *Z* could safely have won the tenth trick (trumping his partner's Diamond 8), and placed the lead again in *Y*'s hand by leading a small spade.—FIVE OF CLUBS.

As you call Cavendish's hand No. 38, set out in your number for February 2 "one of the finest hands ever played," you will perhaps admit some remarks on it adverse to your opinion:—

Trick 1.—The Score being 4 all, *A* ought clearly to have led Queen of Clubs.

Trick 3.—*A*, as pointed out by you, ought not to have returned the trump lead.

Trick 7.—*B* ought to have led Eight of Clubs, and thus made sure that he or his partner would be fourth player in the next trick. *A* playing the ten of Diamonds cannot have the nine.

Trick 8.—As *B* discards Eight of Clubs, he must have three Spades, and *Y* must hold the Nine of Diamonds. As *Z* can now make certain of the game if his partner holds the Ace of Spades, and if he has it not must lose it, he ought, at this trick, to have trumped the Diamond, and then have led the King of Spades, and afterwards a small one. Not trumping, he ought to have discarded the Ten of Clubs, and not the King of Spades, for this reason—that (as he does not trump) he cannot win the game unless *Y* holds the Ace of Spades, and at trick 9 leads a Diamond. Should *Y* do this, then if *Z* retains the King of Spades, he is certain of winning, but by discarding it he cannot win unless his partner also holds the Eight of Diamonds or Queen of Spades; this will be at once seen if at trick 11, *Y* had to lead a losing Diamond or a losing Spade. So that *Z* played doubly wrongly—I will not say badly.

Trick 9. Here again *Z* played wrongly, as by discarding the ten of Clubs he could, if his partner had another Diamond (even the losing one) as well as the Ace of Spades, make certain of winning; whereas, by trumping, he cannot win unless his partner holds the best Diamond or the Queen of Spades; so that, in fact, whilst the *grand coup* was palpably forced on *Z*, he ought to have played it at trick 8 instead of at trick 9. Not having played it at trick 8, he ought to have waited till trick 10. *Y* also, knowing that the game cannot be won unless *Z* has three trumps, and also if King and Knave are two of them, unless he can get rid of the third by trumping, ought to have led the eight of Diamonds as an inducement to *Z* to trump, instead of the 9th.

So that it seems to me that there were altogether seven mistakes in the play; *A* making two, *B* one, *Y* one, and *Z* two, and that the play consequently does not deserve the unqualified praise you bestow on it. MOGUL.

Our esteemed correspondent rather misinterprets our expression of opinion as to the game in question. We referred to the brilliancy of the finish, not to the play right through. With most of "Mogul's" criticisms we agree. The discard of Spade King at trick 8,

XUM

which looks so good, will not bear criticism, unless *Z* thought that *A*, at trick 7, might have perhaps played a false card. This may have been the case, as the game was a real one, and *A* may have been not over-strong, and therefore disposed to erratic courses. We do not, however, agree with "Mogul" that, after trick 8, as played, *Z* should have deferred the *grand coup* to trick 10. There was the risk that, after the Diamond nine, the Ace of Spades might have been led. The risk was, perhaps, less than the chance that *Y* held either Diamond eight or Spade Queen, "especially as Cavendish describes *Y* as a very good player;" but it may have seemed to *Z* worth considering. "Mogul" points out an error in our note on trick 9, in the words "it matters not which;" but as we had already in type a correction of this obvious error, we omit the foot-note relating to this point. "Mogul" will read with interest the extract from Cavendish's "Card Table Talk."

Our Chess Column.

By Mephisto.

GAME PLAYED RECENTLY IN A METROPOLITAN CLUB, MATCH BETWEEN MESSRS. HOON AND TARRANT.

FRENCH DEFENCE.

White. Hoon.	Black. Tarrant.	White. Hoon.	Black. Tarrant.
1. P to K4	P to K3	12. R to Q4	Q to K2
2. P to Q4	P to Q4	13. B to Kt5	P to K4
3. Kt to QB3	B to Kt5 (*a*)	14. R to Q6 (*h*)	Q to K sq
4. B to Q3 (*b*)	P to QB4	15. B takes Kt	Q takes Kt
5. P takes BP	B takes P (*c*)	16. B takes RP (ch) (*i*)	K to R sq (*j*)
6. Kt to B3 (*d*)	Q to Kt3 (*e*)	17. Kt takes P	P takes B
7. Castles	P takes P	18. Q to R5	K to Kt2
8. B takes P	Kt to KB3	19. Kt takes P (*k*)	Q to KKt5
9. Kt to QR4	B takes P (ch) (*f*)	White mates in three moves (*l*)	
10. R takes B	Q to Kt5		
11. R to Q2 (*g*)	Castles		

NOTES.

(*a*) This is not advisable. The Bishop is wanted for the defence of the King's side, and nothing is gained by taking the Queen's Knight; either B to K2 or Kt to KB3 must be played.

(*b*) This move has been resorted to by strong players, notably by Mackenzie at Vienna. We think P takes P first to be safer.

(*c*) A weak move. He subjects himself to the loss of a Pawn by 6. P takes P, P takes P. 7. B to Kt5 (ch). Instead of B takes P, Black ought to have played 5. P takes P, which would have given him a good game, *i.e.*,

	5. P takes P
6. B takes P	6. Q takes Q (ch)
7. K takes Q	7. B takes P

with a good game, which may be perhaps indirectly traced to White's fourth move.

(*d*) White preferred to develop his game to winning the Pawn.

(*e*) A further loss of time, moreover, to no purpose.

(*f*) Black thought he could recover the piece and be a Pawn to the good; in this, however, he was mistaken.

(*g*) An excellent resource. White threatens to win by R to Q8 (ch), he thereby wins a piece.

(*h*) White pursues his advantage with great energy.

(*i*) A well-conceived attack, which speedily secures victory.

(*j*) This is the worst of two evils. If 16. K takes B, supposing 17. Kt to Kt5 (ch), K to Kt sq. 18. Q to R5, B to B5, Black might have defended himself a little longer.

(*k*) The finishing touch. If R takes Kt, then mate in three by Q to Kt6, Kt8, and Q8 (ch).

(*l*) By 20. Q to R6 (ch), K takes Kt. 21. Q takes P (ch), K to K sq. 22. R to Q8 (mate).

SOLUTION.

Problem No. 74, by C. Planck, p. 94.

1. Q to R sq	1. K to B3 (best)
2. Q to KR8	2. K to Kt2
3. Q to QR8 mate.	

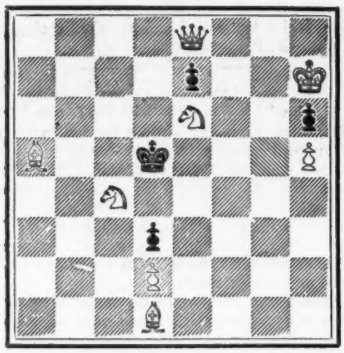
If 2. K to Q2. 3. Q to Q8 mate, or 2. K to B4. 3. Q to B3 mate.

Problem No. 76 is rather a good specimen of a Problem on the block system; it is, however, incorrect as it appeared in print, but it can easily be rectified by simply placing the Rook from Q sq to Q2.

PROBLEM No. 77.

By T. W. Combe.

Black.



White.

White to play and mate in two moves.

ANSWERS TO CORRESPONDENTS.

*** *Please address Chess Editor.*

J. Senior.—See solution above of No. 74.

John Watson.—Solutions of Nos. 74 and 76 incorrect.

East Marden.—If in No. 74, 1. Q to KB8, K to B5. 2. Q to B3, K to Q5, and there is no mate.

J. W. R. and E. C. C.—See solution above of No. 74.

Berrow.—In Problem No. 74, the three Pawns are essential to the idea. Without them White could at once play 1. Q to QR8, and in reply to K to B3 he could move his King and mate next move.

W. J. W. R.—In the Prize Problem, Black cannot play 1. K takes B, as the Knight defends; remember it is the QKt that plays to Kt5.

A. J. Maas, A. J. Mott.—Problems received with thanks.

Correct solutions received.—Problem No. 73, M. T. H., J. S. Maskery. No. 74, Joseph Trenner, W. J. W. R., J. Hughes, Berrow, Roland Mott, P. L. Pavitt, H. E. Dand, A. B. P. No. 75, John Watson, Clarence, John Simpson, T. T. Dorrington, R. J. P., G. Woodcock, W. No. 76, John, W., John Simpson, Clarence, T. T. Dorrington, Schmucke, G. Woodcock, R. J. P.

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